LISTING OF THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (currently amended) A topographic data processor comprising:

means for selecting a pair of frames from a plurality of candidate picture frames of a target area captured from a plurality of orbits ~~different high-altitude positions~~, each frame of the pair of frames having been independently captured on a unique orbit of the plurality of orbits, said pair of frames constituting a stereoscopic image of said target area;

means for determining a parallax between the selected frames and producing therefrom a first plurality of line-of-sight vectors and a second plurality of line-of-sight vectors; and

means for converting said first and second pluralities of line-of-sight vectors to topographic data.

2. (original) A topographic data processor as claimed in claim 1, wherein said frame selecting means comprises:

frame combining means for combining said candidate frames into a plurality of pairs of frames which constitute a stereoscopic image of said target area; and

evaluating means for evaluating each of said pairs of frames with a fitness value indicative of fitness of said each pair of frames to topographic measurement of said target area.

3. (original) A topographic data processor as claimed in claim 2, wherein said evaluating means comprises:

a geometric condition analyzer for analyzing said pairs of frames in terms of their geometric condition and evaluating said pairs of frames with a fitness value proportional to their image resolution; and

decision making means for making a decision on the fitness values obtained from all pairs of frames and selecting one of said pairs of frames having the highest fitness value.

4. (original) A topographic data processor as claimed in claim 3, wherein said parallax determining means determines a parallax between the frames of each said pair of frames, and

wherein said evaluating means further comprises frame matching analyzing means for analyzing said pairs of frames in terms of degree of match between the paired frames and evaluating said pairs of frames with a fitness value proportional to an average value of point-to-point correlations between said paired frames,

wherein said decision making means produces a total value of the fitness values of each of said pairs of frames and selecting one of said pairs of frames having the highest total value.

5. (original) A topographic data processor as claimed in claim 2, wherein said parallax determining means comprises:

frame aligning means for aligning the frames of said selected pair in orientation; and

correlation calculating means for calculating point-to-point correlations between the aligned frames.

6. (original) A topographic data processor as claimed in claim 4, wherein said parallax determining means comprises:

frame aligning means for aligning the frames of said selected pair so that the frames are equally oriented; and

correlation calculating means for calculating point-to-point correlation values between the aligned frames and supplying the calculated correlation values to said frame matching analyzing means, and

wherein the frame matching analyzing means calculates said average value of point-to-point correlations from the correlation values supplied from the correlation calculating means.

7. (original) A topographic data processor as claimed in claim 4, wherein said parallax determining means further comprises an interpolator for interpolating one of the paired frames before said frames are aligned in orientation so that said frames of said pair have equal value of resolution.

8. (original) A topographic data processor as claimed in claim 2, wherein said evaluating means further comprises filtering condition analyzing means for analyzing each of said pairs of frames in terms of filtering condition and evaluating each said pair of frames with a fitness value representative of filtering characteristics of image sensors.

9. (original) A topographic data processor as claimed in claim 2, wherein said evaluating means further comprises sunlight condition analyzing means for analyzing each of said pairs of combined frames in terms of sunlight condition and evaluating each said pair of frames with a fitness value representative of degree of similarity in shadow and shading effects between the frames of each said pair.

10. (original) A topographic data processor as claimed in claim 2, wherein said evaluating means further comprises time difference analyzing means for analyzing each of said pairs of combined frames in terms of time difference and evaluating each said pair of frames with a fitness value inversely proportional to a time difference between the instant one of the frames of said each pair is captured and the instant the other frame is captured.

11. (original) A topographic data processor as claimed in claim 1, further comprising storage medium for storing a plurality of picture frames captured by airborne image sensors, wherein said selecting means selects said pair of frames from said storage medium.

12. (original) A topographic data processor as claimed in claim 10, wherein said frame combining means includes area selecting means for selecting picture frames covering said target area from all picture frames stored in said storage medium.

13. (original) A topographic data processor as claimed in claim 1, further comprising an image sensing scheduler comprising:

image sensor selecting means for selecting at least one airborne image sensor if an appropriate frame is not available to constitute said stereoscopic image and sensing picture frames from the selected image sensor;

frame combining means for combining the sensed picture frames to form a plurality of pairs of received frames which may constitute a stereoscopic image of said target area;
evaluating means for evaluating each pair of sensed frames with a fitness value indicative of fitness of said each pair of frames to topographic measurement of said target area; and

means for producing a schedule for selecting one or more airborne sensors based on the fitness values obtained from all pairs of sensed frames.

14. (original) A topographic data processor as claimed in claim 13, wherein said evaluating means comprises a geometric condition analyzer for analyzing said pairs of sensed frames in terms of their geometric condition and evaluating said pairs of frames with a fitness value inversely proportional to quantum errors between the frames of each said pair.

15. (original) A topographic data processor as claimed in claim 14, wherein said evaluating means comprises filtering condition analyzing means for analyzing each of said pairs of sensed frames in terms of filtering condition and evaluating each said pair of sensed frames with a fitness value representative of filtering characteristics of image sensors.

16. (original) A topographic data processor as claimed in claim 14, wherein said evaluating means further comprises sunlight condition analyzing means for analyzing each of said pairs of sensed frames in terms of sunlight condition and evaluating each said pair of sensed frames with a fitness value representative of degree of similarity in shadow and shading effects between the frames of each said pair.

17. (original) A topographic data processor as claimed in claim 14, wherein said evaluating means further comprises time difference analyzing means for analyzing each of said pairs of sensed frames in terms of time difference and evaluating each said pair of sensed frames with a fitness value inversely proportional to a time difference between the instant one of the frames of said each pair is captured and the instant the other frame is captured.

18. (withdrawn - previously presented) A topographic data processor as claimed in claim 1, further comprising:

scheduling means for selecting at least one airborne image sensor if an appropriate frame is not available in said plurality of candidate frames, and sensing picture frames from the selected image sensor as said plurality of candidate frames, whereby said frame selecting means uses the sensed picture frames to select a new pair of frames.

19. (withdrawn - previously presented) A topographic data processor as claimed in claim 18, wherein said scheduling means comprises:

means for combining the received picture frames to form a plurality of pairs of sensed frames which may constitute a stereoscopic image of said target area;

evaluating means for evaluating each pair of sensed frames with a fitness value indicative of fitness of said each pair of frames to topographic measurement of said target area; and

scheduling means for producing a schedule for sensing picture frames from one or more airborne image sensor based on fitness values obtained from all said pairs of sensed frames.

20. (withdrawn) A topographic data processor as claimed in claim 19, wherein said evaluating means comprises a geometric condition analyzer for analyzing said pairs of sensed frames in terms of their geometric condition and evaluating said pairs of frames with a fitness value inversely proportional to quantum errors between the frames of each said pair.

21. (withdrawn) A topographic data processor as claimed in claim 20, wherein said evaluating means further comprises filtering condition analyzing means for analyzing each of said pairs of sensed frames in terms of filtering condition and evaluating each said pair of sensed frames with a fitness value representative of filtering characteristics of image sensors.

22. (withdrawn) A topographic data processor as claimed in claim 20, wherein said evaluating means further comprises sunlight condition analyzing means for analyzing each of said pairs of sensed frames in terms of sunlight condition and evaluating each said pair of sensed

frames with a fitness value representative of degree of similarity in shadow and shading effects between the frames of each said pair.

23. (withdrawn) A topographic data processor as claimed in claim 20, wherein said evaluating means further comprises time difference analyzing means for analyzing each of said pairs of sensed frames in terms of time difference and evaluating each said pair of sensed frames with a fitness value inversely proportional to a time difference between the instant one of the frames of said each pair is captured and the instant the other frame is captured.

24. (withdrawn - previously presented) A topographic measurement system comprising:

at least one image sensor mounted on a vehicle flying over a target area;

means for sensing a plurality of picture frames at different positions by using said image sensor as a plurality of candidate frames;

means for selecting a pair of frames from said plurality of candidate frames, said pair of frames constituting a stereoscopic image of said target area;

means for determining a parallax between the selected frames and producing therefrom a first plurality of line-of-sight vectors and a second plurality of line-of-sight vectors; and

means for converting said first and second pluralities of line-of-sight vectors to topographic data.

25. (withdrawn) A topographic measurement system as claimed in claim 24, wherein said frame selecting means comprises:

frame combining means for combining said candidate frames into a plurality of pairs of frames which constitute a stereoscopic image of said target area;

evaluating means for evaluating each of said pairs of frames with a fitness value indicative of fitness of said each pair of frames to topographic measurement of said target area; and

decision means for selecting one of said pairs of frames based on fitness values obtained from all said pairs of sensed frames.

26. (withdrawn) A topographic measurement system as claimed in claim 25, wherein said evaluating means comprises:

a geometric condition analyzer for analyzing said pairs of frames in terms of their geometric condition and evaluating said pairs of frames with a fitness value proportional to their image resolution; and

decision making means for making a decision on the fitness values obtained by all pairs of frames and selecting one of said pairs of frames having the highest fitness value.

27. (withdrawn) A topographic measurement system as claimed in claim 26, wherein said parallax determining means determines a parallax between the frames of each said pair of frames, and

wherein said evaluating means further comprises frame matching analyzing means for analyzing said pairs of frames in terms of degree of match between the paired frames and evaluating said pairs of frames with a fitness value proportional to an average value of point-to-point correlations between said paired frames,

wherein said decision making means produces a total value of the fitness values of each of said pairs of frames and selecting one of said pairs of frames having the highest total value.

28. (withdrawn) A topographic measurement system as claimed in claim 25, wherein said parallax determining means comprises:

frame aligning means for aligning the frames of said selected pair in orientation; and

correlation calculating means for calculating point-to-point correlations between the aligned frames.

29. (withdrawn) A topographic measurement system as claimed in claim 27, wherein said parallax determining means comprises:

frame aligning means for aligning the frames of said selected pair in orientation; and

correlation calculating means for calculating point-to-point correlation values between the aligned frames and supplying the calculated correlation values to said frame matching analyzing means, and

wherein the frame matching analyzing means calculates said average value of point-to-point correlations from the correlation values supplied from the correlation calculating means.

30. (withdrawn) A topographic measurement system as claimed in claim 27, wherein said parallax determining means further comprises an interpolator for interpolating one of the paired frames before said frames are aligned in orientation so that said frames of said pair have equal value of resolution.

31. (withdrawn) A topographic measurement system as claimed in claim 25, wherein said evaluating means further comprises filtering condition analyzing means for analyzing each of said pairs of frames in terms of filtering condition and evaluating each said pair of frames with a fitness value representative of filtering characteristics of image sensors.

32. (withdrawn) A topographic measurement system as claimed in claim 25, wherein said evaluating means further comprises sunlight condition analyzing means for analyzing each of said pairs of combined frames in terms of sunlight condition and evaluating each said pair of frames with a fitness value representative of degree of similarity in shadow and shading effects between the frames of each said pair.

33. (withdrawn) A topographic measurement system as claimed in claim 25, wherein said evaluating means further comprises time difference analyzing means for analyzing each of said pairs of combined frames in terms of time difference and evaluating each said pair of frames with a fitness value inversely proportional to a time difference between the instant one of the frames of said each pair is captured and the instant the other frame is captured.

34. (withdrawn) A topographic measurement system as claimed in claim 24, further comprising storage medium for storing a plurality of picture frames captured by airborne image sensors, wherein said selecting means selects said pair of frames from said storage medium.

35. (withdrawn) A topographic measurement system as claimed in claim 34, wherein said frame combining means includes area selecting means for selecting frames covering said target area from all frames stored in said storage medium.

36. (withdrawn) A topographic measurement system as claimed in claim 24, further comprising an image sensing scheduler comprising:

sensor selecting means for selecting at least one airborne image sensor if an appropriate frame is not available to constitute said stereoscopic image and sensing picture frames from the selected image sensor;

frame combining means for combining the received picture frames to form a plurality of pairs of sensed frames which may constitute a stereoscopic image of said target area;

evaluating means for evaluating each pair of sensed frames with a fitness value indicative of fitness of said each pair of frames to topographic measurement of said target area; and

scheduling means for producing a schedule for selecting one or more airborne sensors based on the fitness values obtained from all pairs of sensed frames.

37. (withdrawn) A topographic measurement system as claimed in claim 36, wherein said evaluating means of said scheduler comprises a geometric condition analyzer for analyzing said pairs of sensed frames in terms of their geometric condition and evaluating said pairs of frames with a fitness value inversely proportional to quantum errors between the frames of each said pair.

38. (withdrawn) A topographic measurement system as claimed in claim 37, wherein said evaluating means of the scheduler further comprises filtering condition analyzing means for analyzing each of said pairs of sensed frames in terms of filtering condition and evaluating each said pair of sensed frames with a fitness value representative of filtering characteristics of image sensors.

39. (withdrawn) A topographic measurement system as claimed in claim 37, wherein said evaluating means of the scheduler further comprises sunlight condition analyzing means for

analyzing each of said pairs of sensed frames in terms of sunlight condition and evaluating each said pair of sensed frames with a fitness value representative of degree of similarity in shadow and shading effects between the frames of each said pair.

40. (withdrawn) A topographic measurement system as claimed in claim 37, wherein said evaluating means of the scheduler further comprises time difference analyzing means for analyzing each of said pairs of sensed frames in terms of time difference and evaluating each said pair of sensed frames with a fitness value inversely proportional to a time difference between the instant one of the frames of said each pair is captured and the instant the other frame is captured.

41. (withdrawn - previously presented) A topographic measurement system as claimed in claim 24, further comprising:

scheduling means for selecting at least one image sensor if an appropriate frame is not available in said plurality of candidate frames, and sensing picture frames from the selected image sensor as said plurality of candidate frames, whereby said frame selecting means uses the sensed picture frames to select a new pair of frames.

42. (withdrawn) A topographic measurement system as claimed in claim 41, wherein said scheduling means comprises:

frame combining means for combining the received picture frames to form a plurality of pairs of sensed frames which may constitute a stereoscopic image of said target area;

evaluating means for evaluating each pair of sensed frames with a fitness value indicative of fitness of said each pair of frames to topographic measurement of said target area; and

decision means for producing a schedule for sensing picture frames from one or more airborne image sensors based on fitness values obtained from all of said pairs of sensed frames.

43. (withdrawn) A topographic measurement system as claimed in claim 42, wherein said evaluating means comprises a geometric condition analyzer for analyzing said pairs of sensed frames in terms of their geometric condition and evaluating said pairs of frames with a fitness value inversely proportional to quantum errors between the frames of each said pair.

44. (withdrawn) A topographic measurement system as claimed in claim 43, wherein said evaluating means further comprises filtering condition analyzing means for analyzing each of said pairs of sensed frames in terms of filtering condition and evaluating each said pair of sensed frames with a fitness value representative of filtering characteristics of image sensors.

45. (withdrawn) A topographic measurement system as claimed in claim 43, wherein said evaluating means further comprises sunlight condition analyzing means for analyzing each of said pairs of sensed frames in terms of sunlight condition and evaluating each said pair of sensed frames with a fitness value representative of degree of similarity in shadow and shading effects between the frames of each said pair.

46. (withdrawn) A topographic measurement system as claimed in claim 43, wherein said evaluating means further comprises time difference analyzing means for analyzing each of said pairs of sensed frames in terms of time difference and evaluating each said pair of sensed frames with a fitness value inversely proportional to a time difference between the instant one of the frames of said each pair is captured and the instant the other frame is captured.

47. (currently amended) A computer readable storage medium containing a program executable by a computer to perform the steps of:

a) selecting a pair of frames from a plurality of candidate picture frames of a target area captured from a plurality of orbits ~~different high-altitude positions~~, each frame of the pair of frames having been independently captured on a unique orbit of the plurality of orbits, said pair of frames constituting a stereoscopic image of said target area;

b) determining a parallax between the selected frames and producing therefrom a first plurality of line-of-sight vectors and a second plurality of line-of-sight vectors; and

c) converting said first and second pluralities of line-of-sight vectors to topographic data.

48. (currently amended) A computer readable storage medium as claimed in claim [[45]]47, wherein step (a) comprises:

a_1) combining said candidate frames into a plurality of pairs of frames which constitute a stereoscopic image of said target area;

a_2) evaluating each of said pairs of frames with a fitness value indicative of fitness of said each pair of frames to topographic measurement of said target area; and

a_3) selecting one of said pairs of frames based on fitness values obtained from all said pairs of frames.

49. (original) A computer readable storage medium as claimed in claim 48, wherein step (a_2) comprises:

a_{2-1}) analyzing said pairs of frames in terms of their geometric condition and evaluating said pairs of frames with a fitness value proportional to their image resolution; and

a_{2-2}) making a decision on the fitness values obtained by all pairs of frames and selecting one of said pairs of frames having the highest fitness value.

50. (original) A computer readable storage medium as claimed in claim 48, wherein step (b) determines a parallax between the frames of each said pair of frames, and

wherein step (a_2) further comprises the step (a_{2-3}) of analyzing said pairs of frames in terms of degree of match between the paired frames and evaluating said pairs of frames with a fitness value proportional to an average value of point-to-point correlations between said paired frames,

wherein step (a_{2-2}) produces a total value of the fitness values of each of said pairs of frames and selecting one of said pairs of frames having the highest total value.

51. (original) A computer readable storage medium as claimed in claim 47, wherein step (b) comprises:

b_1) aligning the frames of said selected pair in orientation; and

b_2) calculating point-to-point correlations between the aligned frames.

52. (original) A computer readable storage medium as claimed in claim 50, wherein step (b) comprises:

b_1) aligning the frames of said selected pair so that the frames are equally oriented; and

b_2) calculating point-to-point correlation values between the aligned frames, and wherein step ($a_{2\text{-}3}$) calculates said average value of point-to-point correlations from the correlation values calculated by step (b_2).

53. (original) A computer readable storage medium as claimed in claim 51, wherein step (b) further comprises interpolating one of the paired frames before step (b_1) is performed so that said frames of said pair have equal value of resolution.

54. (original) A computer readable storage medium as claimed in claim 49, wherein step (a_2) further comprises analyzing each of said pairs of frames in terms of filtering condition and evaluating each said pair of frames with a fitness value representative of filtering characteristics of image sensors.

55. (original) A computer readable storage medium as claimed in claim 49, wherein step (a_2) further comprises analyzing each of said pairs of combined frames in terms of sunlight condition and evaluating each said pair of frames with a fitness value representative of degree of similarity in shadow and shading effects between the frames of each said pair.

56. (original) A computer readable storage medium as claimed in claim 49, wherein step (a_2) further comprises analyzing each of said pairs of combined frames in terms of time difference and evaluating each said pair of frames with a fitness value inversely proportional to a time difference between the instant one of the frames of said each pair is captured and the instant the other frame is captured.

57. (original) A computer readable storage medium as claimed in claim 47, further comprising the steps of:

c) selecting at least one airborne image sensor if an appropriate frame is not available to constitute said stereoscopic image and sensing picture frames from the selected image sensor;

d) combining the received picture frames to form a plurality of pairs of sensed frames which may constitute a stereoscopic image of said target area;

e) evaluating each pair of sensed frames with a fitness value indicative of fitness of said each pair of frames to topographic measurement of said target area; and

f) producing a schedule for selecting one or more airborne sensors based on the fitness values obtained from all pairs of sensed frames.

58. (original) A computer readable storage medium as claimed in claim 57, wherein step (e) comprises analyzing said pairs of sensed frames in terms of their geometric condition and evaluating said pairs of frames with a fitness value inversely proportional to quantum errors between the frames of each said pair.

59. (original) A computer readable storage medium as claimed in claim 57, wherein step (e) further comprises analyzing each of said pairs of sensed frames in terms of filtering condition and evaluating each said pair of sensed frames with a fitness value representative of filtering characteristics of image sensors.

60. (original) A computer readable storage medium as claimed in claim 57, wherein step (e) further comprises analyzing each of said pairs of sensed frames in terms of sunlight condition and evaluating each said pair of sensed frames with a fitness value representative of degree of similarity in shadow and shading effects between the frames of each said pair.

61. (original) A computer readable storage medium as claimed in claim 57, wherein step (e) further comprises analyzing each of said pairs of sensed frames in terms of time difference and evaluating each said pair of sensed frames with a fitness value inversely proportional to a time difference between the instant one of the frames of said each pair is captured and the instant the other frame is captured.

62. (previously presented) A computer readable storage medium as claimed in claim 47, further comprising the steps of:

selecting at least one airborne image sensor if an appropriate frame is not available in said plurality of candidate frames, and sensing picture frames from the selected image sensor as said

plurality of candidate picture frames, and repeating step (a) to select a new pair of frames from said sensed picture frames.

63. (original) A computer readable storage medium as claimed in claim 62, wherein step (a) comprises:

a_1) combining the received picture frames to form a plurality of pairs of sensed frames which may constitute a stereoscopic image of said target area; and

a_2) evaluating each pair of sensed frames with a fitness value indicative of fitness of said each pair of frames to topographic measurement of said target area.

64. (original) A computer readable storage medium as claimed in claim 63, wherein step (a_2) comprises analyzing said pairs of sensed frames in terms of their geometric condition and evaluating said pairs of frames with a fitness value inversely proportional to quantum errors between the frames of each said pair.

65. (original) A computer readable storage medium as claimed in claim 64, wherein step (a_2) further comprises analyzing each of said pairs of sensed frames in terms of filtering condition and evaluating each said pair of sensed frames with a fitness value representative of filtering characteristics of image sensors.

66. (original) A computer readable storage medium as claimed in claim 64, wherein step (a_2) further comprises analyzing each of said pairs of sensed frames in terms of sunlight condition and evaluating each said pair of sensed frames with a fitness value representative of degree of similarity in shadow and shading effects between the frames of each said pair.

67. (original) A computer readable storage medium as claimed in claim 64, wherein step (a_2) further comprises analyzing each of said pairs of sensed frames in terms of time difference and evaluating each said pair of sensed frames with a fitness value inversely proportional to a time difference between the instant one of the frames of said each pair is captured and the instant the other frame is captured.

68. (original) A computer readable storage medium as claimed in claim 64, wherein step (a_2) further comprises analyzing each of said pairs of frames in terms of degree of match between the frames of each pair and evaluating each said pair of frames with a fitness value proportional to an average value of point-to-point correlations between said paired frames.